

yet been published, and even a fragment like the present, containing a list of the species of a neighbouring region, is a welcome addition to our knowledge. Four other "Parts" have been issued on the Insecta—the "Neuroptera" and "Hymenoptera" (both in 1878), and the "Lepidoptera" and "Rhynchota" (both in 1879); the last Part of the whole series being the "Araneidea" (1885).

Popular Astronomy. By Sir George B. Airy, K.C.B. Seventh Edition. Revised by H. H. Turner, M.A., B.Sc. (London: Macmillan and Co., 1891.)

ALTHOUGH our astronomical knowledge has been enormously extended since the lectures forming the basis of this well-known book were delivered (1848), Mr. Turner has not found it necessary to make any very considerable revision, for the reason that the advances have been chiefly on the chemical and physical sides. Still, in the lapse of time, methods of observation have been improved, and accounts of these find a place in Mr. Turner's notes. Among these are short descriptions of the chronograph and the new "electrical controls" for the driving-clocks of equatorials. One of the most noteworthy points brought out in the new edition, however, is the modern estimate of the value of observations of the transit of Venus as a means of determining the solar parallax. It was formerly supposed that this would be one of the best methods, but the difficulties encountered in 1874 and 1882 prevented observations of the necessary degree of accuracy; and now most astronomers are of opinion that this method can never give more than an approximation to the truth. Numerous minor additions have also been judiciously made.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Force and Determinism.

"THE relation between force, which is a mechanical thing, and will or life, or whatever it is, which is a psychological thing"—a relation which, as Dr. Lodge rightly says, "demands investigation"—presents itself to some of us as follows.

When a stimulus received by an organism gives rise to a response, however particular to the individual respondent, there are (1) a number of complex but determinate molecular changes in the organic tissues; and (2), accompanying some of these changes, certain psychological states. Are these psychological states produced by the molecular changes? or are the molecular changes produced or in any way guided by the psychological states? Neither the one nor the other. The molecular changes and the psychological states are different aspects of the same occurrences. In other words, they are distinguishable (and the distinction is absolute), but not divisible.

"The energy displayed by a gang of navvies is not theirs, but their victuals"; they simply direct it." In physiological language it is the outcome of the proper functioning of their cerebral control-centres. Now we believe that, although we can at present by no means adequately explain them, all the molecular occurrences within the organism, forming, as we believe they do, an orderly and determinate sequence between stimulus and response, whether they involve force or energy, are of such a nature as to be explicable in physical and physiological terms. The fact that certain phases of the sequence have also a subjective or psychological aspect does not, it is held, justify us in changing our point of view, and ignoring the distinction between the psychology and the physiology of the process.

Now to say that mind, or will, or consciousness directs the organic energy along a definite path we regard as incorrect, because it ignores a distinction which we hold to be valid and valuable, and conducive to clear thinking on these difficult subjects. But we have no such objection to the statement that

the energy is guided by molecular forces which have for their subjective aspect certain states of consciousness. To unscientific folk this may sound mere quibbling; but to physicists, who have done so much to teach us the vital importance of accurate language for clear thinking, we look for support in drawing this distinction, unless the distinction can be shown to be either invalid or useless.

This distinction between force, energy, and the physical series (what I have elsewhere spoken of as *kinesis*) on the one hand, and thought, consciousness, and the psychical series (what I have elsewhere spoken of as *metakinesis*) on the other hand, we hold to be absolute; while at the same time we hold that consciousness is indivisible from particular (neural) modes of *kinesis*. And this distinction we hold to be especially valuable when questions of the origin and development of consciousness are under consideration. This may, perhaps, best be expressed by a diagram.



Now, looked at from above, this wriggle is supposed to represent the development, from simple forms of molecular transactions, of that complex form of *kinesis* which we call *neurosis*. From this point of view, all is force and energy or *kinesis*, and can become nothing else. Looked at from below, we have the development of consciousness. From what? We must not say from lower forms of energy or *kinesis*, because that involves jumping across the line, or, in other words, ignoring the distinction. From what, then? From those lower forms of "something-which-is-not-yet-consciousness-but-which-may-develop-into-consciousness," for which I have ventured to coin the term *metakinesis*.

I have elsewhere endeavoured to show that this view is not open to the objection that, since the kinetic sequence is a continuous and determinate one, consciousness is merely a by-product, and that an unconscious Darwin might have written and influenced the conduct of unconscious Englishmen. For consciousness, though it is distinguishable from, is, according to the hypothesis, no less inseparable from, certain complex modes of the kinetic process. As the world is constituted, such supposed *kineses*, separated from their metakinetic aspect, would not be the same *kineses* but something altogether different. In other words, it is with certain molecular transactions which have also a conscious aspect that, in the world of living beings of which we have practical knowledge, we have to deal.

It is essential that physicists and psychologists should work hand in hand. Both are endeavouring to explain the phenomena on positive lines. And if there is anything in the views that I have briefly sketched in the preceding paragraphs which runs counter to the conclusions of physics, it must go by the board, and give place to a more widely-consistent conclusion, to which physics, speaking with the voice of authority in its own special province, can give a cordial assent. C. LLOYD MORGAN.

I AM afraid that, as Prof. Lodge has accepted my "middle paragraph" so easily, he has failed to appreciate its point. For, if that paragraph is correct, the Professor's assertion, "Force is certainly necessary to direct the motion of matter," is only a truism, similar to the important geometrical theorem, "In any right-angled triangle, one angle is equal to 90°." On the other hand, Dr. Croll's assertion, to the effect that guidance is effected by "determinism," and *not* by force, is a contradiction in terms. For, by definition, that which changes motion *is* force. If, therefore, Prof. Lodge's assertion has any real meaning, he must have some independent definition of "force," and I should very much like to know what that is.

Again, Prof. Lodge in no way answers "the crux in my last paragraph." Prof. Lloyd Morgan implies in his last letter that, in the case of the sun altering the direction of motion of the earth, no energy is expended. This is, of course, only approximately true; and even in the case of his twirling his stick round his finger and thumb, as the stick is elastic, its forces of cohesion in reality do some small amount of work. It is indeed true that, if two particles were once connected by an *absolutely* inextensible string, the cohesion of the string would do no work. But what I pointed out was that, in order to bring such

a string into action, it would be necessary to wait till two particles were moving on paths with a common normal—an occurrence which must be infinitely rare. When Prof. Lodge says "an infinite mass can absorb any amount of momentum, without receiving a trace of energy, &c.," he forgets that the term "infinite" is only relative, "an infinite mass" being one whose change of velocity (or kinetic energy) consequent on a given change of momentum is negligible for the purpose in hand. It would not, I imagine, suit Prof. Lodge's purpose to suppose psychic forces might do a *little* work, so long as it was only a *very little*?

May I remind him of the old paradox, "What would happen if an irresistible force were brought to bear against an immovable post?"

EDWARD T. DIXON.

12 Barkston Mansions, South Kensington, July 24.

THE discussion on this topic has gained in clearness by Prof. Lodge's conceding that "the same question—What determines the direction of the transfer of energy?—may doubtless be asked in connection with inanimate activity; . . . but in neither case do I know the answer."

Perhaps some more precision may be attained by expressing the question in other words.

The principle of conservation of energy reigns over the quantitative relations of all processes in nature, but it does not give any explanation of the qualitative changes of those processes. These changes and their conditions must in every case be found out by special experience. But, nevertheless, they are, in every accessible case, found to be subjected to fixed laws. A given substance undergoes evaporation or chemical transformation—dependent on or necessarily bound up with changes of heat into energy of molecular motion, or into chemical energy, or *vice versa*—at a distinct degree of temperature, or under distinct conditions of electrical action. Inexplicable as these transformations of quality or form of energy remain for us, there is nothing undetermined in them, neither have we any right to such a supposition for the qualitative changes going on in plants and animals—their quantitative relations being likewise governed by the principle of conservation of energy.

But there is another phase of the question. Some unknown material changes in the brain are connected with phenomena of consciousness. Nothing can be more fallacious than to consider consciousness as a form of energy, and to suppose it in a relation of equivalence to such forms. How it is, that what to our physical conception, or outer sense, are processes in the brain (which, as such, may be more clearly understood in future), are, at the same time, to our psychical conception, or inner sense, phenomena of consciousness, or acts of will, is a question beyond the domain of physical science, and capable of elucidation only by transcendental philosophy. Whoever wishes for more light here, must study the "Kritik der reinen Vernunft," especially the chapters "Von den Paralogismen" and "Die Antinomien."

Schopenhauer, and others after him, have considered our power of will, or our conscious directing of motion, as the key for all qualitative processes in nature, these being considered as, in their essence, acts of will. But this is cutting the knot by means of a metaphysical assumption.

D. WETTERHAN.

Freiburg, Badenia, July 27.

IN reading over the remarks of Dr. Lodge and Prof. Morgan upon Dr. Croll's views as to the direction of force, it appears to me that both have missed the point. Dr. Croll did not mean that a force at right angles to another does no work, but simply alters the direction. His view is that the change of direction is not caused by a force. Dr. Lodge says it is, although he acknowledges that the second force does no work. Further, Dr. Croll says, with regard to the first force, that its direction is quite apart from the force. The force cannot direct itself. This is the crucial point before we get to a second force or to a right angle. I fully acknowledge the importance of Dr. Lodge's principle, but it is not simply the indorsement of Dr. Croll's idea.

Prof. Morgan thinks Dr. Croll's view no argument in favour of theism. It does not prove that mind can or does affect matter. Perhaps it does not directly prove this, but, within its range, it seems to me an effective reply to mechanical atheism. We see direction, and if this does not come from force it must

come from some other source. We know of no other source but mind. To talk of mind affecting matter denies the essence of mind by which it is distinct from matter, and makes it a mechanical *ab extrâ*. But try to banish it and it will come in somewhere. "Tamen usque recurret."

Dr. Croll's position seems to me to affect the first law of motion. Uniform motion in a straight line is in no way connected essentially with force, if his view is correct.

Dr. Lodge's principle appears to affect the second law of motion, and also the doctrine of impact and transference of force.

Further, it affects gravity. Gravity is always at right angles to the first law of motion, and therefore gravity is not a force; for that can not be a force which never exercises force.

T. TRAVERS SHERLOCK.

Congregational Church, Smethwick, July 25.

Technical Education for Farmers, Farriers, and Engine-Drivers.

KNOWING that you take very great interest in the various questions relating to technical education, I may give you a few particulars of an experiment which the Devon County Agricultural Society recently made at its Exmouth meeting. Being desirous of giving farmers, farriers, and those generally interested in the welfare of horses, some information on the scientific principles which underlie a proper performance of the duties of the farrier, and the correct form and mode of attachment of horses' shoes; and also of giving farmers and engine-drivers some practical and scientific instructions on the working and care of steam-engines, the Society approached the County Council with a view to a grant in aid of their object. The proposal was very warmly taken up by Mr. Lethbridge and other gentlemen who are well known for their active interest in education and other matters important to the welfare of the county, and a grant was obtained.

The Society secured the services of Prof. F. Smith, head of the Army Veterinary School, Aldershot, and of Mr. W. Worby Beaumont, and by these gentlemen lectures were given on each of the three days of the Society's meeting at Exmouth. The weather was very unfavourable on two days, but notwithstanding this the attendance at the lectures was large, and on the second and third days was larger than was expected, and was fully up to the accommodation provided. The audiences were remarkably attentive and appreciative, and in every respect the experiment proved successful. Many who were sceptical before the lectures of their value to working men, became convinced that not only is it possible to give working men information which is useful in an important degree in their daily work, but that the men are themselves quick to appreciate its value. I may mention that on one of the days nearly two hundred shoeing-smiths and a large number of farmers attended the horse-shoeing lectures, and on one day seventy-eight engine-drivers entered for the lecture on the steam-engine, and there were also in attendance a large number of working and gentlemen farmers.

Totnes, July 29.

JOHN L. WINTER.

THE ERUPTION OF VESUVIUS OF JUNE 7, 1891.

THE suggestion that I published in several newspapers has been fully confirmed—namely, that the second alternative type of eruptive character would be pursued by the volcano. Now for a period of over a month lava has continued to dribble forth, activity has returned to the central vent, and no great changes have occurred.

The throat of the volcano commenced to be cleared on June 9, the vapour forcing its way up from the crater bottom through the choke of loose materials, and rose above as a column carrying with it much dust; at the same time the powerful vapour blast issuing from the upper extremity of the lateral rift, of which mention is made in my first letter, soon stopped. Each day I was kept informed of the state of the volcano by the kindness of Messrs. Ferber and Treiber, the director and engineer respectively of the Vesuvian Railway.

On June 15 I considered it right to again visit the